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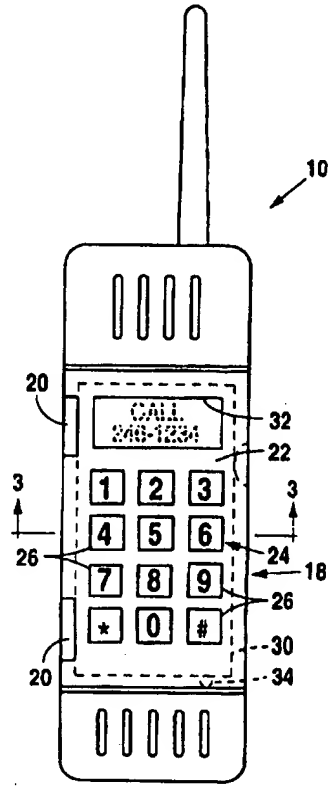
(54) Title: TACTILE KEYPAD FOR TOUCH SENSITIVE SCREEN

(57) Abstract

A telecommunication instrument having a touch sensitive screen is provided with a cover panel that is rotatably mounted on the body of the instrument and is movable between open and closed positions. In the closed position, a tactile feedback keypad mounted in the cover panel provides positive contact with corresponding areas of the surface of the touch sensitive screen. When the cover panel is in the open position, the touch sensitive screen is exposed whereby displayed messages and data may be read, and if so equipped, finger or pen-input signals recorded.



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TACTILE KEYPAD FOR TOUCH SENSITIVE SCREEN

BACKGROUND OF THE INVENTION

Technical Field

This invention relates generally to keypads for telecommunication instruments, and more particularly to a tactile keypad arrangement for use with an instrument having a touch sensitive screen.

History of Related Art

Touch sensitive keypad panels have been proposed for use in telecommunication instruments such as cellular phones, integrated pager/telephones, and personal radios. Touch sensitive keypad panels, heretofore commonly found in personal-digital-assistant (PDA) and pen-input notepads, are generally reconfigurable between signal input and output display modes, using the smooth surface of the panel to provide both the pen-and/or touch-input signals and output display. Such touch sensitive keypad panels are now being proposed for use in telecommunication instruments. Examples of smooth surface touch sensitive panels include liquid crystal display (LCD) panels, analog resistive touch screens (ARTS) and other electrostatic and electromagnetic screens which support touch and/or pen input. One signal input mode of such panels and screens is a keypad display arranged to generate touch input signals.

A major disadvantage of such touch sensitive screens is the lack of positive tactile feedback to the operator. For example, it is difficult sense, by touch feedback, whether the screen area was touched with sufficient force to generate a desired signal. Typically, a user of such devices must visually confirm, via a display area, the input data to assure correct operation. Even when provided with audio feedback, many users still find touch sensitive screens to be undesirable.

Also, touch sensitive screens are typically very fragile and can be easily scratched or damaged. Furthermore, telecommunication instruments having LCD keypads are often used in cold environments in which the keypad surface temperature may be close or equal to the ambient temperature. Under such conditions, the LCD keypad panel display becomes very dark, making it hard to read, and the display response time becomes very slow. To overcome this problem, the LCD panel is often heated. However, heating the panel dramatically increases the power drain on battery-operated portable instruments, thereby adversely affecting critical battery life.

The present invention is directed to overcoming the problems set forth above. It is desirable to have a telecommunication instrument with a touch sensitive screen that provides a visual display panel and the ability to input data by finger, or optionally by stylus, and additionally have a selectively operable tactile feedback keypad. It is also desirable to have such a telecommunication instrument in which the selectively operable tactile feedback keypad is normally disposed in protective covering relationship over the touch sensitive screen, and capable of being moved from the covering relationship when it is desired to directly input data via the screen panel. It is also desirable to have a telecommunication instrument with a touch sensitive screen that can be operated by a tactile feedback keypad in cold environments.

SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention, a telecommunication instrument has a touch sensitive screen mounted in a body. A cover panel is rotatably mounted on the body and is movable between a closed position at which the cover panel is disposed in a covering position over the touch sensitive screen, and an open position at which the cover panel is spaced from

the touch sensitive screen. A plurality of keys are mounted in the cover panel and are arranged so that they are aligned with predesignated areas of the touch sensitive screen when the cover is in the closed position. Each of the keys are movable, when the cover panel is closed, between a first position at which the key is spaced a predetermined position from the touch sensitive screen and a second position at which the key is in touching contact with a respective one of the predesignated areas of the touch sensitive screen.

Other features of the telecommunication instrument embodying the present invention include the touch sensitive screen being a liquid crystal display panel, and the cover panel comprising a premolded keypad mounted in a substantially rigid frame.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the structure and operation of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a plan view of a telecommunication instrument embodying the present invention, with the movable cover panel in a closed position;

Fig. 2 is a plan view of a telecommunication instrument embodying the present invention, showing the movable cover panel in an open position; and

Fig. 3 is a cross-sectional view of a telecommunication instrument embodying the present invention, taken along the line 3-3 of Fig. 1.

DETAILED DESCRIPTION OF A PRESENTLY PREFERRED EXEMPLARY EMBODIMENT

The term "telecommunication instrument" as used herein means electrical instruments of the type used to transmit voice and/or other data signals over relatively long distances. Examples of such instruments include

cellular telephones and radios, pagers, personal-digital-assistant (PDA) and pen-input notebooks having signal transmitting and receiving capabilities, and the like. In particular, the present invention is directed to such telecommunication instruments that use a smooth touch-sensitive screen to input and display data. Such screens are often selectively reconfigurable to initially provide a reference screen, such as an alphanumeric display corresponding with designated areas on the screen to provide a dialing function, and subsequently to provide selective display of messages or data and input of messages and data by writing or touch. Such screens generally include electrostatic screens, liquid crystal display (LCD) panels, and electromagnetic screens such as the Dynaclear-4™ Analog Resistive Touch Panel (ARTS) produced by Dynapro Thin Film Products, Milwaukee, WI.

In the preferred embodiment of the present invention, a cellular telephone **10** has a touch sensitive LCD panel **12** mounted in a body **14**. To provide light under dark or low-light conditions, a backlight panel **16** is mounted in the body **14** at a position below the normally transparent LCD panel. In the illustrative embodiment, the LCD panel **12** is operable in a initial receiving and dialing mode in which a short message or number and a designated key pattern may be displayed on preselected areas of the panel **12** as indicated by dashed lines in Fig. 2, and reconfigurable to a larger message and data display mode encompassing the entire panel subsequent to establishing communication with another instrument.

Importantly, the telecommunication instrument **10** has a movable cover panel **18** that is rotatably mounted on the body **14** by conventional hinges **20**. The cover panel **18** is movable between a closed position, as illustrated in Fig. 1, at which the cover panel **18** is disposed in a protective covering relationship over the touch sensitive screen **12** and a open position, as shown in Fig. 2, at

which the cover panel **18** is rotated away from the touch sensitive screen **12**.

In the preferred embodiment of the present invention, the cover panel comprises a relatively rigid frame **22** and a premolded keypad **24** that includes a plurality of individual keys **26** interconnected by relatively thin web sections **28**. In the illustrated embodiment, the keys **26** are arranged in a conventional twelve-key telephone configuration. However, it should be recognized that other key arrangements, including additional function keys or even twenty-six english alphabet keys, may be used as needed for specific applications.

In the preferred embodiment of the present invention, the keypad **24** is preferably formed by molding and is constructed of a substantially clear or translucent silicon rubber material. The light-transmitting properties of clear or translucent materials enables light provided by the backlight panel **16** to pass through the keys **26**, enabling a user to identify specific keys. Numbers or other character symbols may either be molded in the top surface of each key or provided by a cap having an opening defining the desired character, pressed over the top of each key.

If the touch sensitive screen does not have a light source to provide transmitted light illumination of the keys, such as that provided by the backlight panel **16** typically used in LCD applications, the bottom surface of the frame **22** may be used as a mounting surface for light-emitting components such as light-emitting diodes (LED's).

As best shown in Fig. 3, the premolded keypad **24** is desirably controllably positioned in a mold cavity , and then the frame **22** formed, by injection molding, around the keypad **24**, thereby providing a single integral structure. This arrangement is economical to fabricate and assures positive retention and positioning of the keys

26 with respect to corresponding areas of the touch sensitive screen 12 when the cover panel 18 is in the closed position. To provide a controlled clearance between the bottom of the keys 26 and the touch sensitive surface of the touch screen 12, the frame 22 is provided with a spacing ridge 30 that extends at least partially around the lower peripheral edge of the frame 22. The spacing ridge 30 has a thickness sufficient to assure a controlled clearance between the bottom of the keys 26 and the touch sensitive surface of the touch screen 12.

The frame 22 is desirably constructed of conventional thermoplastic or thermoset plastic materials having a molding temperature less than the melting temperature of the keypad material. Suitable materials for the frame 22 include, but are not limited to, ABS resins, cellulosic plastics, phenolic resins, phenylene oxide resins, polycarbonate, polyester, polystyrene, polyurethane and polyvinyl chloride. When integrally formed with the frame 22, the keypad 24 is desirably formed of an elastomeric material having sufficient deflection characteristics so that when the top of a key 26 is depressed by a finger, the bottom surface of the key will move downwardly into touch contact with the surface of the touch sensitive screen 12. Even though the frame 22 is constructed of relatively rigid materials, it can be readily understood that a small amount of localized deflection may occur when a key is depressed, thereby further aiding in the touch contact of the bottom of the key 26 with the touch sensitive screen 12. Alternatively, the keypad 24 may comprise a plurality of separately formed keys 26. For example, the keys 26 may be spherically- shaped domes, often called Poplars, which pop under contact pressure and deflect the bottom surface of the key 26 downwardly into touch contact with the touch sensitive screen 12. Other materials and constructions of the keys 26 may be used, including mechanical or spring-biased arrangements, provided that they provide a

positive tactile feedback to the operator when depressed by the operator's finger.

If the telecommunication instrument **10** is provided with a paging or other message function capable of being displayed on a preselected portion of the touch sensitive screen **12**, or if the instrument **10** is capable of displaying a number as it is being dialed, the cover panel **18** may be conveniently provided with a clear opening, or window, **32** aligned with the message portion so that the return call or dialed number, can be conveniently referenced or confirmed while dialing the number on the tactile feedback keypad **24**.

In operation, a user will typically place an outgoing call by punching a designated number sequence on the keypad **24** with the cover panel **18** in the closed position as illustrated in Fig. 1. As noted above, if the telecommunication instrument **10** is equipped with a paging or other message generating device, the message may be referenced through the opening **32** without opening the cover panel **18**. In a similar manner, the dialed number may be confirmed without opening the cover panel **18**. After using the tactile feedback keypad **24** to place a call, the cover panel **18** may be opened, as shown in Fig. 2, to provide access to the touch sensitive screen **12**. A signal for reconfiguring the touch sensitive screen **12** from a dialing mode to a message and data display or transmitting mode may be conveniently provided by a spring biased push-button switch **34** mounted in the body **14**. When the cover panel **18** is in the closed position, the switch **34** will be depressed by a portion of the spacing ridge **30** at the edge of the frame **22**, and the controller for the touch sensitive screen **12** will use that condition to configure the dialing mode. When the cover panel **18** is opened, the switch **34** will be released providing a signal to the touch sensitive screen **12** so that the screen **12** can be reconfigured to a desired alternate use.

Although the present invention is described in terms of a preferred exemplary embodiment, those skilled in the art will recognize that changes in cover panel construction and materials may be made without departing from the spirit of the invention. For example, the keypad **24** may have a different key arrangement than that shown, and the tactile feedback keys **26** may have a different construction and be formed of different materials than that suggested. It is also recognized that the art of smooth surface touch sensitive screens is rapidly changing, and new screen constructions with enhanced capabilities are certain to appear. Such changes are intended to fall within the scope of the following claims. Other aspects, features and advantages of the present invention can be obtained from a study of this disclosure and drawings, along with the appended claims.

WHAT IS CLAIMED IS:

1. A telecommunication instrument comprising:

a body;

a touch sensitive screen mounted on said body;

A cover panel rotatably mounted on said body and movable between a closed position at which said cover panel is disposed in a covering position over and adjacent to said touch sensitive screen, and an open position at which said cover panel is spaced from said touch sensitive screen;

a plurality of keys mounted in said cover panel and arranged in a predetermined pattern corresponding with respective predesignated areas of said touch sensitive screen, each of said keys being movable between a first position spaced a predetermined distance from said touch sensitive screen and a second position in touching contact with said respective predesignated area of the touch sensitive screen when said cover panel is disposed at said closed position.

2. A telecommunication instrument, as set forth in Claim 1, wherein said touch sensitive screen is a liquid crystal display panel.

3. A telecommunication instrument, as set forth in Claim 1, wherein said cover panel comprises a frame and a premolded keypad having said plurality of keys integrally formed therewith, said keypad being mounted in said frame.

4. A telecommunication instrument, as set forth in Claim 3, wherein said frame is formed of a substantially rigid plastic material.

5. A telecommunication instrument, as set forth in Claim 3, wherein said keypad is formed of translucent silicon rubber.

6. A telecommunication instrument, as set forth in Claim 3, wherein a plurality of thin web sections interconnect said plurality of keys.

7. A telecommunication instrument, as set forth in Claim 3, wherein said frame includes a spacing ridge for assuring a controlled clearance between said keys and said touch sensitive screen.

8. A telecommunications instrument, as set forth in Claim 3, wherein said frame includes a window for viewing a portion of the touch sensitive screen when said cover panel is disposed in the covering position.

9. A telecommunication instrument comprising:

a body;

a touch sensitive screen mounted on said body;

a cover panel rotatable mounted on said body movable between a closed position at which said cover panel is disposed in a covering position over and adjacent to said touch sensitive screen, and an open position at which said cover panel is spaced from said touch sensitive screen;

a plurality of keys mounted in said cover panel and arranged in a predetermined pattern corresponding with respective predesignated areas of said touch sensitive screen, each of said keys being movable between a first position spaced a predetermined distance from said touch sensitive screen and a second position in touching contact with said respective predesignated area of the touch sensitive screen when said cover panel is disposed at said closed position;

a spacing ridge forming a portion of said cover panel for assuring a controlled clearance between said keys and said touch sensitive screen; and

a push-button switch mounted in said body and aligned with said spacing ridge when said cover panel is disposed in the closed position, said cover panel depressing said push button switch to configure the touch sensitive screen of said telecommunication instrument in a dialing mode when said cover panel is disposed in the closed position, otherwise, to configure the touch sensitive screen of said telecommunication instrument in a display mode when said cover panel is disposed in the open position.

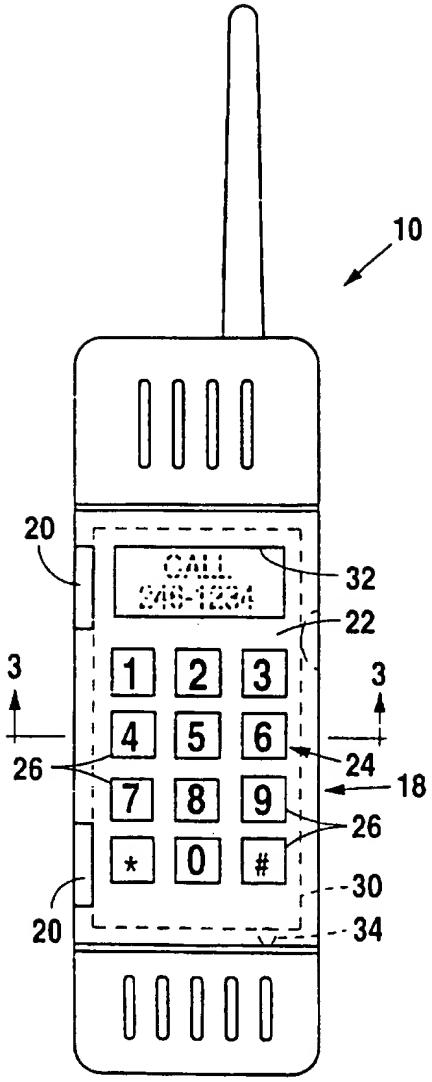

Fig. 1

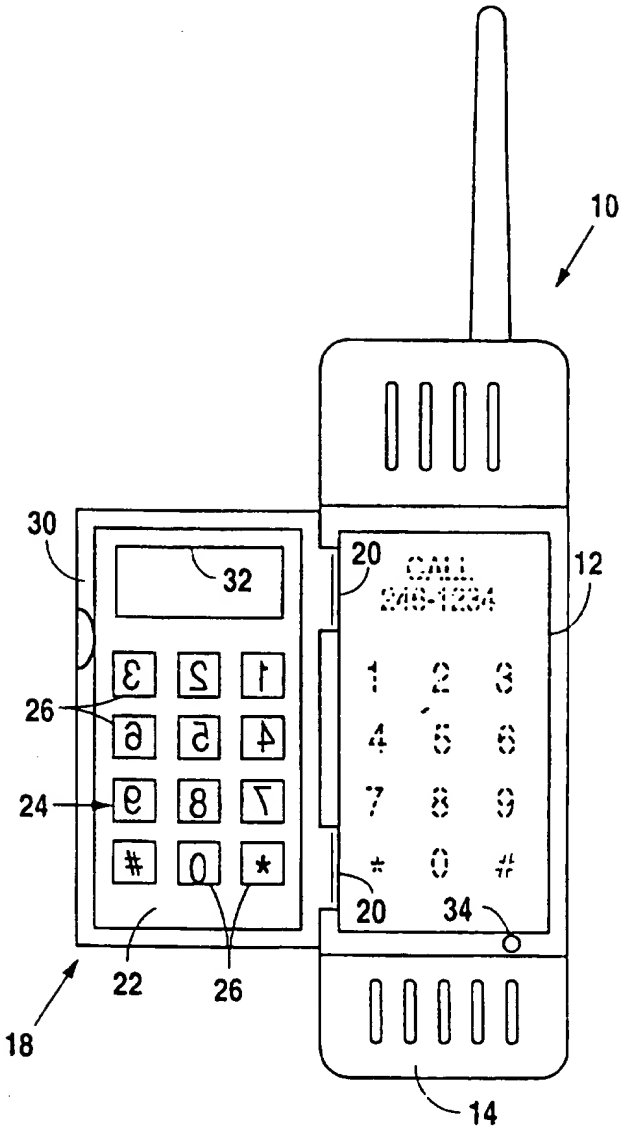

Fig. 2

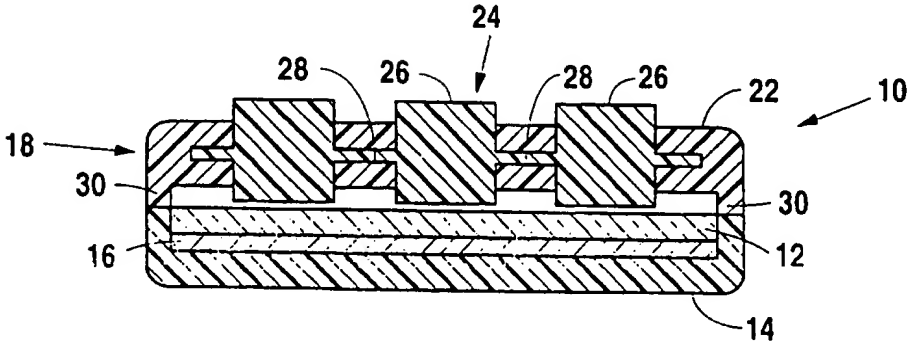

Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/05557

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04M1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 291 560 A (MOTOROLA INC) 24 January 1996	1-3,7,8
A	see page 1, line 29 - page 3, line 32; figures 1,2	4-6
Y	see page 3, line 14 - line 19	9

Y	EP 0 678 987 A (NIPPON ELECTRIC CORP.) 25 October 1995	9
	see column 3, line 23 - line 49; figure 1	
	see column 6, line 9 - line 24; figure 5	

X	US 5 414 444 A (BRITZ) 9 May 1995	1-3,8
	see column 2, line 9 - column 4, line 15; figures 1-6	

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
4 August 1997	13 AUGUST 1997

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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